

# NEA Scout and Lunar Flashlight: Two Near-Term Interplanetary CubeSat Missions

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NASA is developing two small satellite missions as part of the Advanced Exploration Systems (AES) Program, both of which will use a solar sail to enable their scientific objectives. Solar sails reflect sunlight from a large, mirror-like sail made of a lightweight, highly reflective material to provide thrust. This continuous photon pressure provides propellantless thrust, allowing for very high  $\Delta V$  maneuvers in space. *Lunar Flashlight*, managed by the NASA Jet Propulsion Laboratory, will search for and map volatiles in permanently shadowed lunar craters using a solar sail as a gigantic mirror to steer sunlight into them, then examine the reflected light with a spectrometer. The *Lunar Flashlight* spacecraft will also use the solar sail to maneuver into a lunar polar orbit. The mission will demonstrate a low-cost capability to explore, locate and estimate the size and composition of ice deposits on the Moon. The Near Earth Asteroid (NEA) Scout mission, managed by the NASA Marshall Space Flight Center will survey and image a Near Earth Asteroid for possible future human exploration using a smallsat propelled by a solar sail. Detections of NEAs are expected to grow in the near future, offering increasing target opportunities. Obtaining and analyzing relevant data about these bodies via robotic precursors before committing a crew to visit them is essential. The *NEA Scout* spacecraft is nearly identical to the one being developed for *Lunar Flashlight*, with the science instrument package being the primary difference. The *NEA Scout* solar sail will provide the primary propulsion taking the 6U cubesat from near the Earth to its final asteroid destination and the *Lunar Flashlight* sail will provide the propulsion necessary for its spacecraft to enter lunar orbit. Both projects will use an 85 m<sup>2</sup> solar sail developed by NASA MSFC.

The *NEA Scout* and *Lunar Flashlight* flight systems are based on a 6U cubesat form factor, with a stowed envelope of 10x20x30cm and a mass of less than 12 kg. The solar sail for *NEA Scout* and *Lunar Flashlight* will be based on the technology developed and flown by the NASA *NanoSail-D* and The Planetary Society's *Lightsail-A*. Four 7 m stainless steel booms wrapped on two spools (two overlapping booms per spool) will be motor deployed and pull the sail from its stowed volume. The sail material will be 3  $\mu$ m CP1, an aluminized polyimide that was extensively tested for solar sail applications. The sail will spooled rather than Z-folded.

This paper will describe both the *Lunar Flashlight* and *NEA Scout* missions and their solar sails.